

## How Does a Satellite Communicate With the Earth?

### INTRODUCTION

Some military 'spy' satellites take pictures with actual film. The film canisters are ejected back to Earth and caught in mid-air by waiting aircraft. Most modern satellites send their scientific data back to earth in long strings of numbers. These numbers provide information about the brightness of millions of image 'pixels' taken by satellite-born, electronic cameras. In this activity, students will have hands on experiences in the communication processes of satellites.

### OBJECTIVES

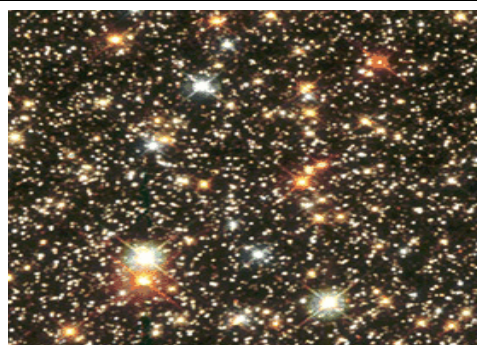
- Students will learn that satellites use a transmitter and receiver system of sending information.
- Students will learn how a satellite communicates the information it has gathered.

#### MATERIALS NEEDED:

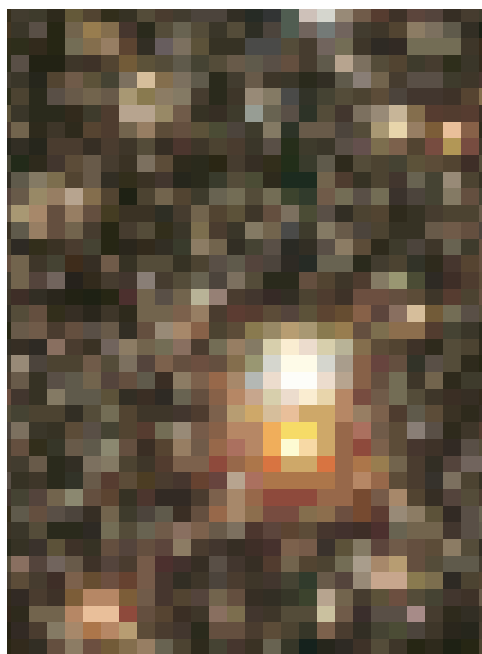
- 1...Flashlight
- 2...Mirror
- 3...5x5 grid graph paper
- 4...10x10 grid graph paper
- 5...List of coordinates

### CONCLUSION

The students will learn how a satellite communicates information to the earth. They will use "color" filters to produce an image that mimics the way information about images is sent from a satellite.

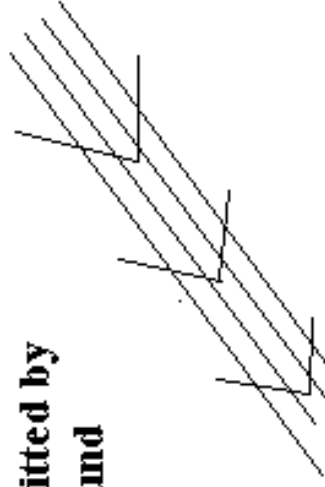


A magnified photo showing 'pixels'





**IMAGE  
Satellite**



**Streams of data transmitted by  
radio waves, to the ground  
receiver.**



**Goldstone  
Tracking  
Station**

- Darken the room, and shine the flashlight at the mirror. Have the students observe the path of the light. A satellite "sends" its data by reflecting off mirrors and directing it to the satellite dish on the earth's surface at a distant point.

- Students should play the "gossip" game, where a message is repeated from student to student. The student is the "transmitter" when saying the message to a classmate, and is the "receiver" when hearing the message from a classmate. While some students are being the transmitters, make some background noise. Compare this to satellite interference.

- When a satellite is communicating it does not speak in words, but in numbers. These numbers correspond to a location on the grid system. In many instances, the transmission of these numbers is done three times, once from each of the cameras. Each set of numbers transmitted refers to a color filter. When the completed filters are placed on top of each other, the true colors in the image are seen. The activities below use this grid system to transmit information from one student to another.

#### ***Grade K***

- The students will be "read" a set of numbers that correspond to the location on the grid. One student reading the information to the other student can accomplish this, or the teacher can read it to the class. The square at that location will be colored in the corresponding color. The students will be read three lists. The areas that are colored in will make an image as a satellite does when it transmits data.

#### ***Grades 1-3***

- The students will be "read" a pair of coordinates for a location on the coordinate graph. One student reading the information to the other student can accomplish this or the teacher can read it to the class. The students will color the square its corresponding color. After the three "filters" or colors have been transmitted, the colors will form an image as a satellite does when it transmits data.

#### ***Grades 4-6***

- The students will be "read" a pair of coordinates for a location on the coordinate graph. One student reading the information to the other student can accomplish this or you can read it to your class. The students will color the square its corresponding color. After the three "filters" or colors have been transmitted, the colors will form an image as a satellite does when it transmits data. Please note that the coordinate graph for these students is a 10 x 10 grid.

*Grades 1 - 3*

- Students should draw a set of pictures with captions to show the sequence of data transmission from a satellite. They could make it in a sequence frame format or in story format.

*Grades 4-6*

- Students should develop their "own" pictures to be transmitted via their classmates. They should write the coordinates keeping in mind that the three primary colors could be mixed to form other colors. They could then make a sequence frame to show the steps involved in satellite transmission.

When reading or giving these coordinates, remember to have the student's color with the correct color. You will actually be reading three lists of coordinates.

**Kindergarten graphing coordinates:**

Yellow: 1, 5, 7, 8, 9, 12, 14, 16,  
17, 18, 19, 20, 21, 23, and 25

Red: 2, 3, 4, 6, 10, 11, 13, and 15

Blue: 2, 3, 4, 6, 10, 11, 15, 22, and 24

**Grades 1-3 graphing coordinates:**

Yellow: (1, 1), (2, 1), (4, 1), (5, 1), (1, 2),  
(3, 2), (5, 2), (2, 3), (3, 3), (4, 3),  
(2, 4), (4, 2), (1, 5), (3, 5), (5, 5)

Red: (3, 1), (2, 2), (4, 2), (1, 3), (5, 3),  
(1, 4), (3, 4), (5, 4), (2, 5), (4, 5)

Blue: (1, 1), (2, 1), (4, 1), (5, 1), (1, 2),  
(3, 2), (5, 2), (2, 3), (3, 3), (4, 3),  
(2, 4), (4, 4), (1, 5), (3, 5), (5, 5)

### Grades 4-6 graphing coordinates:

Yellow: (7, 2), (7, 3), (8, 3), (3, 4), (4, 4),  
(5, 4), (6, 4), (7, 4), (8, 4), (3, 5),  
(4, 5), (5, 5), (6, 5), (7, 5), (3, 6),  
(4, 6), (1, 7), (2, 7), (3, 7), (4, 7)

Red: (5, 1), (6, 1), (4, 2), (5, 2), (6, 2),  
(4, 3), (5, 3), (6, 3), (5, 6), (6, 6),  
(7, 6), (8, 6), (5, 7), (6, 7), (7, 7),  
(8, 7), (9, 7), (1, 8), (2, 8), (3, 8),  
(4, 8), (5, 8), (6, 8), (7, 8), (8, 8),  
(2, 9), (3, 9), (4, 9), (5, 9), (6, 9),  
(7, 9), (3, 10), (4, 10), (5, 10)

Blue: (1, 1), (2, 1), (3, 1), (4, 1), (7, 1),  
(8, 1), (9, 1), (10, 1), (1, 2), (2, 2),  
(3, 2), (7, 2), (8, 2), (9, 2), (10, 2),  
(1, 3), (2, 3), (3, 3), (7, 3), (8, 3),  
(9, 3), (10, 3), (1, 4), (2, 4), (3, 4),  
(4, 4), (5, 4), (6, 4), (7, 4), (8, 4),  
(9, 4), (10, 4), (1, 5), (2, 5), (3, 5),  
(4, 5), (5, 5), (6, 5), (7, 5), (8, 5),  
(9, 5), (10, 5), (1, 6), (2, 6), (3, 6),  
(4, 6), (9, 6), (10, 6), (1, 7), (2, 7),  
(3, 7), (4, 7), (10, 7), (9, 8), (10, 8),  
(1, 9), (8, 9), (9, 9), (10, 9), (1, 10),  
(2, 10), (6, 10), (7, 10), (8, 10), (9, 10), (10, 10)

## Culminating Activity

Working in cooperative groups the students will complete a "life cycle" of a satellite. For the older students who designed a research satellite, the cycle begins with the decision process. For the younger students, the cycle begins with the launch of the satellite on the rocket. Each group's mural should include pictures and captions of how a satellite gets into and remains in orbit, and how a satellite communicates information. Students can use a long roll of paper or smaller papers attached together. Display the completed projects.

## Kindergarten Graph

21	22	23	24	25
16	17	18	19	20
11	12	13	14	15
6	7	8	9	10
1	2	3	4	5

**Grades 1-3 Graph**


## Grades 4-6 Graph

